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An das
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March 1, 2006

WO-Patent Application No.: PCT/JP2004/018870
Applicant: TOYOTA JIDOSHA KABUSHIKI KAISHA
Our Ref.: WO 46098 (Frist: 3.3.06/R 66 Eing.)

This is in reply to the second written opinion of the International Preliminary Examining Authority dated February 16, 2006.

The applicant requests the issuance of an International Preliminary Report on patentability on the basis of new claims 1 to 9 filed with the letter of January 20, 2006 and identified as "new claims 1 to 9 for Second Auxiliary Request". These new claims should replace the hitherto valid claims on which the second written opinion was based.

Since the Examining Authority has already considered such a new claim 1 restricted to only tantalum and hafnium addition as hard particle formers together with a low cobalt content to be distinguished from the available prior art, it is assumed that the new claims 1 to 9 amended accordingly fulfill all requirements of the substantial patentability according to the PCT. Furthermore, the applicant would like to emphasize that the Examiner has already hold out the prospect for the issuance of a positive International Preliminary Examination Report on

the basis of said claims in the informal interview held on February 8, 2006.

If, however, there are still minor deficiencies in the new claims or if the International Preliminary Examining Authority has further objections as to the patentability of the new claims, it is suggested that the representative should be contacted by telephone in order to be able to react on these new objections.

Dr. G. Chivarov
Patentanwalt
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January 20, 2006

WO-Patent Application No.: PCT/JP2004/018870
Applicant: TOYOTA JIDOSHA KABUSHIKI KAISHA
Our Ref.: WO 46098 (Frist: 22.01.2006/Eing.)

This is in reply to the written opinion of the International Preliminary Examining Authority dated November 22, 2005.

**I. Main Request**

The issuance of a fully positive International Preliminary Report on patentability is requested based on the facts and arguments below.

1. Novelty

The subject-matter of claim 1 is novel over the wear-resistant copper-based alloy according to D1, because of the difference in the cobalt content.

Furthermore, the subject-matter of claim 1 is novel over the disclosure of D2, because of the addition of tantalum, titanium, zirconium and hafnium in a specific amount, instead of the alloying elements molybdenum, tungsten and vanadium.

## 2. Inventive Step

### 2.1 Starting from D1 as the closest prior art

According to the applicant's view, D1 is considered to be the closest prior art document, because the copper-based alloy described therein overlaps in most of the contents of the components, except the amount of cobalt contained therein.

With regard to the cobalt content of less than 2.0% by weight, D1 teaches that the high-melting point composite compounds are produced in an insufficient amount to degrade the wear-resistance of the resulting copper-based alloy (please see page 5, lines 29/30 of D1). In contrast to the teaching of D1, the problem of the present application is to enhance the wear-resistance in a high temperature range, but also to enhance the crack-resistance and the machinability in a balanced manner (please see e.g. the passage bridging pages 3 and 4 as well as page 4, lines 16 and 17 of the present application).

As you can see from paragraph [0027], the upper limit of the cobalt content, i.e. above 2.00% by weight cobalt, the coarseness of the hard phase sharply increases which results in an increase in aggressiveness against a mating member, poor toughness of the resultant wear-resistant copper-based alloy and easy cracking when the resultant alloy is clad on a target object. Thus, even though the wear-resistance may be improved by adjusting the cobalt content as defined in D1 (from 2.0 to 15.0% by weight), the copper-based alloy easily cracks and has a poor toughness. Consequently, the wear-resistance in a high temperature range, the crack-resistance as well as the machinability would not be in a balanced manner.

This has been achieved, according to the present invention, by reducing the cobalt content and the nickel content and including one or more of tantalum, titanium, zirconium and hafnium in the ranges as defined in new claim 1 (please see paragraph [0010] on page 5 of the present application).

Since, however, the teaching of D1 leads the skilled person away from lowering the content of cobalt of the copper-based alloy, the skilled person would not consider this specific feature of claim 1 of the present invention. Hence, the subject-matter of new claim 1 involves an inventive step over D1.

As D1 teaches that the high-melting point composite compounds are produced in an insufficient amount to degrade the wear-resistance of the resulting copper-based alloy when lowering the Co content in the copper-based alloy according to D1 (please see page 5, lines 29/30 of D1), D1 leads the skilled person away from the present invention. Therefore, the skilled person looking for improving the wear-resistance of a copper-based alloy in a high temperature range would not combine the teaching of D1 with that of D2, in which a cobalt content of 0.01 to 2.0% by weight is suggested (cf. pages 1 and 2 of D2). Therefore, since the skilled person would not combine D1 and D2, he is not prompted to the wear-resistance copper-based alloy fulfilling all structural features of claim 1 of the present application.

Hence, since the skilled person would not combine the features of documents D1 and D2 with each other, the claims as presently on file indeed involve an inventive step over the cited prior art documents D1 and D2.

2.2 Starting from D2 as the closest prior art

When starting from document D2 as the closest prior art, the subject-matter of claim 1 differs from the wear-resistant copper-based alloy of D2 by the presence of tantalum, titanium, zirconium and hafnium. Furthermore, the wear-resistant alloy of claim 1 of the present application does not include any of Mo, W, and V as alloying elements.

One or more of tantalum, titanium, zirconium and hafnium in the specified amount of 2.7 to 22.0% enhance the wear-resistance and the lubricity at high temperatures due to the formation of silicides (please see last paragraph on page 13 of the present application).

Thus, the objective problem underlying the present application is to provide an alternative wear-resistant copper-based alloy having a low cobalt-content with improved properties at high temperatures.

From paragraph 37 of D2 the skilled person knows that molybdenum, tungsten and vanadium in a content of 3.0 to 20.0% combined with silicon and iron generates mixed iron silicides, thus enhancing the wear-resistance and the lubricity at high temperatures of wear-resistant copper-based alloys having a low content of cobalt. The skilled person searching for an improvement of wear-resistance in a high temperature range, the crack-resistance as well as the machinability of such copper-based alloys in a balanced manner, knows from D2 that the addition of silicide formers having the ability of forming mixed iron silicides may be applicable. Thus, he would search for alternative silicide formers which can form mixed iron silicides.

Taking into account the teaching of D2, the skilled person does not get any hint to the generation of mixed iron silicides when molybdenum, tungsten and vanadium is used as an alloying element of a wear-resistant copper-based alloy having a high content of cobalt from the disclosure of D1. Namely, D1 merely teaches that Mo, Ti, Zr, Nb or V reacts with Si, Co, Cr or C to produce high-melting point composite compounds, thereby enhancing the wear-resistance of the alloy (please see page 5, line59 to page 6, line 1 of D1). However, D1 is silent as to the effect of said alloying elements with regard to the lubricity of the wear-resistant copper-based alloy obtained from such high-melting point composite compounds.

Thus, since D1 is silent as to the ability of tantalum, titanium, zirconium and hafnium to generate mixed iron silicides as well as to the effect of said alloying elements on the lubricity of the obtained alloy, the skilled person would not expect that improved or similar results with respect to the lubricity at high temperatures would be obtained with the use of merely silicide formers as Ta, Ti, Zr and Hf known from D1 as being wear-resistance enhancing elements.

Furthermore, the high content of cobalt providing an improved wear resistance to the alloys of D1 leads the skilled person away from omitting the alloying elements Mo, W, and V, which are necessary in view of the lubricity of said alloy. Thus, the skilled person would not exchange these elements by alternative silicide formers in order to improve the crack-resistance as well as the machinability of a copper-based alloy.

Hence, the skilled person would exchange molybdenum, tungsten and vanadium as alloying additive with one of

tantalum, titanium, zirconium and hafnium in a wear-resistant copper-based alloy having a low content of cobalt only in a hindsight manner. Thus, this is a clear evidence for the inventive step of the claimed subject-matter.

Consequently, since the teaching of D1 is silent as to the specific effect of the additives tantalum, titanium, zirconium and hafnium with regard to the lubricity of the alloy and the improved lubricity is based on the combination of the low content of cobalt and the use of Mo, W, or V as alloying element for generating mixed iron silicides with Si, the skilled person would not be prompted to combine the teachings of documents D1 and D2.

Moreover, as can be seen from the Table 1 on page 31 of the present application, when using Ta (Ex.1; Sample A10) instead of Mo (Ref. Ex.; Sample I) in a similar wear-resistant copper-based alloy, the crack rate is clearly different in both samples. Thus, no cracks are observed in Sample 10 according to the present invention, wherein a crack rate of 1% is observed in the sample I, in which Ta is exchanged by Mo. Thus, even though the skilled person would combine documents D1 and D2, the skilled person gets no hint to the surprisingly improved crack resistance of the alloy according to the present invention, in which one or more of the elements tantalum, titanium, zirconium, and hafnium are used as alloying elements in combination with a low content of cobalt.

Therefore, the specific combination of the low content of cobalt and the addition of one or more of tantalum, titanium, zirconium and hafnium in the specific amount as defined in claim 1 of the present application involves an inventive step over the teachings of documents D1 and D2, when taken in combination.

In the light of the above, the Examining Division is asked to waive their negative attitude to the inventive step of the claimed subject-matter. Consequently, in the light of the above detailed discussion of the inventive step, the issuance of a fully positive International Preliminary Report is requested.

**II. First Auxiliary Request**

The Examiner is respectfully asked to allow an informal communication by telephone or to schedule a date for a personal consultation with the new representative. The new representative is prepared to informally communicate with the Examiner personally. In order to schedule an informal interview the representative will call the Examiner within short.

In consideration of the outcome of said informal interview, the Examiner is requested to give the applicant an additional opportunity to submit amendments in order to elaborate a claim version on which basis the Examiner is prepared to issue a fully positive International Preliminary Report on patentability.

**III. Second Auxiliary Request**

The issuance of an International Preliminary Report on patentability on the basis of the amended claims (New Claims 1 to 9 for Second Auxiliary Request) as enclosed herewith is requested, in case the Examining Division is not prepared to allow one of the above Requests (Main Request and First Auxiliary Request).

It is noted that such amended claims, restricted to only Ta and Hf addition as hard particle formers, have been considered to be novel and inventive over the cited prior art documents in the above-mentioned written opinion.

Hence, the issuance of a fully positive International Preliminary Report on patentability or the scheduling of an informal interview between the Examiner and the new representative is assumed.

Dr. Georgi Chivarov
Patentanwalt
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Encl.:
- New Claims 1 to 9 for Second Auxiliary Request

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Enclosure of January 20, 2006

WO-Patent Application No.: PCT/JP2004/018870
Applicant: TOYOTA JIDOSHA KABUSHIKI KAISHA
Our Ref.: WO 46098

**New claims 1 to 9 for Second Auxiliary Request**

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1. A wear-resistant copper-based alloy, comprising, by weight, 4.7 to 22.0% nickel, 0.5 to 5.0% silicon, 2.7 to 22.0% iron, 1.0 to 15.0% chromium, 0.01 to 1.97% cobalt, 2.7 to 22.0% of tantalum and/or hafnium, and the balance of copper with inevitable impurities.

2. A wear-resistant copper-based alloy according to claim 1, wherein silicide is dispersed therein.

3. A wear-resistant copper-based alloy according to claim 1 or 2, further comprising a matrix and hard particles dispersed in said matrix,

said matrix having an average hardness of Hv 130 to 250 and said hard particles having a higher average hardness than that of said matrix.

4. A wear-resistant copper-based alloy according to claim 3, wherein said hard particles have an average particle diameter of 5 to 3000 μm.

5. A wear-resistant copper-based alloy according to one of claims 1 to 4, which is used for cladding.

6. A wear-resistant copper-based alloy according to one of claims 1 to 5, which is used for cladding by being melted by a high-density energy beam and then solidified.

7. A wear-resistant copper-based alloy according to one of claims 1 to 6, which constitutes a cladding layer to be clad on a substrate.

8. A wear-resistant copper-based alloy according to one of claims 1 to 7, which is used for a sliding member.

9. A wear-resistant copper-based alloy according to one of claims 1 to 8, which is used for valve train components for an internal combustion engine.